



Factors for FAA Cost Estimating and Analysis

Investment Cost Analysis Branch (ASD-410)

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1.0 INTRODUCTION

The *Factors for Federal Aviation Administration (FAA) Cost Estimating and Analysis* document provides cost analysts with cost-to-cost factors for predicting the development, implementation, and in-service management costs of select FAA Work Breakdown Structure (WBS) elements as a percentage of the costs of development hardware and software or production hardware.

Candidate factors were identified from a survey of Department of Defense (DoD) and FAA sources and assessed for applicability to the FAA, compatibility with the FAA Standard WBS, the quality of underlying data and documentation, and other criteria. Selected factors were reviewed by the FAA's Investment Cost Analysis division, ASD-410, and may be applied by FAA cost analysts in a variety of applications.

The cost-to-cost factors were developed for application to satisfy the following cost estimating needs:

- Validate contractor or other estimates
- Quickly develop rough order of magnitude (ROM) estimates
- Focus requirements for future cost research efforts

Note: Thorough understanding of Section 4.0, "Application of Estimating Factors" and Appendix B, "Cost Factor Detail" is required by the cost analyst prior to using the cost estimating factors.

2.0 DEFINITION AND OVERVIEW

In order to understand a cost-to-cost factor, the term Cost Estimating Relationship (CER), must first be understood. A CER is a mathematical expression relating the cost of the dependent variable to one or more independent cost-driving variables. There are two fundamental types of CERs:

1. Cost-to-cost CER (or Cost Factor) — where the cost of one element is used to estimate, or predict, the cost of another element
2. Cost-to-non-cost CER — where a characteristic of an item, i.e., weight of the item, is used to estimate, or predict, the cost of the item

3.0 DEVELOPMENT OF ESTIMATING FACTORS

Development of cost estimating and analysis tools within ASD-410 began in July 2001. An initial survey of DoD and FAA organizations identified seven primary sources of cost-to-cost factors (see Appendix A for more detail regarding sources of data) and more than 70 cost factors of possible use to the FAA. Candidate factors and supporting data were assessed and mapped to the relevant cost elements of the FAA standard WBS.

Production WBS elements are estimated as a percentage, or factor, of production hardware costs. Development WBS elements are estimated as a percentage, or factor, of the summation of development hardware/software costs. The ratios of the costs of various Production WBS elements to the production hardware cost were extracted from the data sources. Similarly, the ratios of the costs of various Development WBS elements to the development hardware/software cost were also extracted. Analysis of the factors for each of the identified WBS cost elements produced a ‘low most likely high’ range of values from which the cost estimator may choose the appropriate factor. The value that the estimator chooses should be dependent on several variables, including:

- Hardware intensive or software intensive program
- All Commercial-off-the-Shelf (COTS) or new development
- Minor or major modification

Table 1 summarizes the raw data obtained from the seven data sources for development and production activities. Table 2 provides the resulting final cost-to-cost factors. The factors are printed and distributed, in the form of a laminated card, by ASD-410/SETA-II, and referred to as the “Pocket Estimating Guide (PEG)”.

Table 1: Summary of Cost-to-Cost Factors from Data Sources

Summary of Cost-to-cost Factors for Development Activities (from DoD and FAA Data Sources)									
WBS#	WBS	APO-88-2	DCA 600-60-1	Kanter's Factors ESCP 173-2	ACEIT Analysis	MCR Studies	Low	Mid	High
3.2	System Engineering (Development)	31% - 55%		38% - 84%		80%	31%	60%	86%
3.3.1.2	*PME					150%	100%	150%	200%
3.3.3	HW/SW Integration, Assembly, Test & Checkout	10% - 24%		10%			10%	16%	24%
3.4.1	Facility Planning & Design	2% - 47%					2%	24%	47%
3.5.1	System Development, Test & Eval. (Development)	15% - 22%	5% - 10%	16% - 18%			5%	15%	27%
3.6	Documentation	9% - 24%		6% - 19%			1%	21%	27%
3.7.3	Support & Handling Equipment Acquisition (CSE)	8%		2% - 11%			2%	8%	11%
3.7.4	Support Facility Construction / Conversion / Expansion	14%					10%	14%	20%
3.7.5	Support Equipment Acquisition / Modification (PSE)	1% - 34%	10%	7% - 15%			1%	10%	34%
3.7.7	Initial Spares & Repair Parts Acquisition	1% - 39%		4%			1%	19%	39%
3.7.8	Initial Training	1% - 5%		1%			1%	10%	17%
Summary of Cost-to-cost Factors for Production Activities (from DoD and FAA Data Sources)									
WBS#	WBS	APO-88-2	DCA 600-60-1	Kanter's Factors ESCP 173-2	ACEIT Analysis	MCR Studies	Low	Mid	High
3.3.4	Production Engineering (Production SE/PM)	12% - 32%	20%	25%	25% - 40%		12%	27%	40%
3.4.3	Physical Infrastructure	7% - 21%					7%	13%	21%
3.5.4	Site Acceptance Testing (Production ST&E)	5% - 10%		7%			5%	7%	10%
3.6	Documentation	4% - 6%	4% - 10%	6%	5%		4%	6%	10%
3.7.3	Support & Handling Equipment Acquisition (CSE)	1% - 3%		1%			1%	2%	3%
3.7.5	Support Equipment Acquisition / Modification (PSE)	6% - 10%	10%	2%			2%	10%	23%
3.7.6	Support Facilities & Equipment Maintenance	2%					1%	2%	3%
3.7.7	Initial Spares & Repair Parts Acquisition	7% - 37%	8% - 35%	9%			7%	15%	37%
3.7.8	Initial Training	1% - 3%		1%			1%	2%	3%
4.6	Installation & Checkout	18%	20%	34%			18%	20%	34%
5.3	Modifications		30%				20%	30%	40%
5.8.1	Supply Support		7%				5%	7%	10%
5.8.2	Repair		7% - 24%			10%	7%	10%	24%

Table 2: Cost-to-Cost Factors for Application to FAA Cost Estimates

Cost-to-cost Factors for Application to FAA Cost Estimates (12 Dec 01 Version 0.33)						
Development Activities Factors						
*** Coordinate with ASD-410 before use ***						
WBS	DEVELOPMENT	Low Tendency	Low	ML	High	High Tendency
3.2	System Engineering	Hardware Intensive	31%	60%	86%	Software Intensive
3.3.1.2	*Hardware less NRE, AUC	All COTS	100%	150%	200%	New Development
3.3.3	HW/SW Integration, Assembly, Test & Checkout	Hardware Intensive	10%	16%	24%	Software Intensive
3.4.1	Facility Planning & Design	Software Intensive	2%	24%	47%	Hardware Intensive
3.5.1	System Development, Test & Evaluation	Minor Modification	5%	15%	27%	New Capability
3.6	Documentation	Minor Modification	1%	21%	27%	New Capability
3.7.3	Support & Handling Equipment Acquisition (CSE)	Minor Modification	2%	8%	11%	New Capability
3.7.4	Support Facility Construction / Conversion / Expansion	Software Intensive	10%	14%	20%	Hardware Intensive
3.7.5	Support Equipment Acquisition / Modification (PSE)	Minor Modification	1%	10%	34%	New Capability
3.7.7	Initial Spares & Repair Parts Acquisition	Software Intensive	1%	19%	39%	Hardware Intensive
3.7.8	Initial Training	Minor Modification	1%	10%	17%	New Capability
NRE = non-recurring engineering						
AUC = average unit cost						
CSE = common support equipment						
PSE = peculiar support equipment						
Factors applied to sum of (WBS 3.3.1 HW + WBS 3.3.2 SW) with exception of WBS 3.3.1.2						
*Factor applied to WBS 3.3.5, Production, Average Unit Cost (AUC)						
Production Activities Factors						
*** Coordinate with ASD-410 before use ***						
WBS	PRODUCTION	Low Tendency	Low	ML	High	High Tendency
3.3.4	Production Engineering (Production SE/PM)	Hardware Intensive	12%	27%	40%	Software Intensive
3.4.3	Physical Infrastructure	Software Intensive	7%	13%	21%	Hardware Intensive
3.5.4	Site Acceptance Testing (Production ST&E)	Minor Modification	5%	7%	10%	New Capability
3.6	Documentation	Minor Modification	4%	6%	10%	New Capability
3.7.3	Support & Handling Equipment Acquisition (CSE)	Minor Modification	1%	2%	3%	New Capability
3.7.5	Support Equipment Acquisition / Modification (PSE)	Minor Modification	2%	10%	23%	New Capability
3.7.6	Support Facilities & Equipment Maintenance	Software Intensive	1%	2%	3%	Hardware Intensive
3.7.7	Initial Spares & Repair Parts Acquisition	Software Intensive	7%	15%	37%	Hardware Intensive
3.7.8	Initial Training	Minor Modification	1%	2%	3%	New Capability
4.6	Installation & Checkout	Software Intensive	18%	20%	34%	Hardware Intensive
5.3	Modifications	Software Intensive	20%	30%	40%	Hardware Intensive
5.8.1	Supply Support	Software Intensive	5%	7%	10%	Hardware Intensive
5.8.2	Repair	Software Intensive	7%	10%	24%	Hardware Intensive
SE/PM = system engineering/program management						
ST&E = system test and evaluation						
CSE = common support equipment						
PSE = peculiar support equipment						
Factors applied to WBS 3.3.5, Production Hardware						

(Note: Factors have been rounded to nearest percentage point)

Please see Appendix B for further detail explaining the cost-to-cost factors. Specifically, Appendix B will provide the following information about each factor:

- WBS element
- Phase of activity
- Scope
- Number of sources used to determine the factor
- Minimum factor value
- Maximum factor value
- Typical (most likely) factor value
- Program/product characteristics that require use of low tendency factors
- Program/product characteristics that require use of high tendency factors
- Any relevant comments

4.0 APPLICATION OF ESTIMATING FACTORS

The cost-to-cost factors provided in this document are a useful cost-estimating tool, particularly when validating existing estimates or developing a ROM estimate. Prior to applying the factors, development hardware, development software and production hardware costs must be estimated. Effective use of the cost factors is dependent on accurate hardware and software estimates. Many of the FAA WBS elements need to be expanded to include “Development” and “Production” sub-elements. The WBS elements are provided in Table 3.

Table 3: Expansion of the FAA WBS

WBS #	WBS Sub-Elements (expansion of WBS)	Description
3.3.1		Hardware Design & Development
	3.3.1.1	Non-Recurring Engineering (NRE)
	3.3.1.2	Hardware
3.6		Documentation
	3.6.1	Development
	3.6.2	Production
3.7.3		Support & Handling Equipment Acquisition
	3.7.3.1	Development
	3.7.3.2	Production
3.7.5		Support Equipment Acquisition/Modification
	3.7.5.1	Development
	3.7.5.2	Production
3.7.7		Initial Spares and Repair Parts Acquisition
	3.7.7.1	Development
	3.7.7.2	Production
3.7.8		Initial Training
	3.7.8.1	Development
	3.7.8.2	Production
4.6		Installation and Checkout
	4.6.1	Development
	4.6.2	Production

To accurately apply a development factor, the following steps need to be followed:

- Estimate WBS elements 3.3.1 (Hardware Design and Development) and 3.3.2 (Software Design and Development)
- Sum WBS elements 3.3.1 and 3.3.2 (Software Design and Development) less 3.3.1.2 (Hardware Design less NRE) to determine the development hardware and software cost
- Select a factor that fits the tendency of the program (interpolate as necessary for programs that do not fit a particular tendency) [For example, the cost analyst will need to match, as closely as possible, the characteristics of the program being estimated to the descriptions provided by the “Low Tendency” and “High Tendency” columns of the “Cost-to-Cost Factors for Application to FAA Cost Estimates” table (see Table 2)]
- Multiply the selected factor by the development hardware/software cost

To accurately apply a production factor, the following steps need to be followed:

- Estimate WBS elements 3.3.5 (Production Hardware Cost)
- Select a factor that fits the tendency of the program (interpolate as necessary for programs that do not fit a particular tendency)
- Multiply the selected factor by the production hardware cost

Table 3 below provides a sample of how to apply the cost factors and calculate the resulting WBS element estimate.

Table 4: Sample Application of Cost Factors

Assumptions	
Production Average Unit Cost (AUC)	\$1M
Production Quantity	22 Units
Development Quantity	2 Units
Development Hardware NRE	\$5M
Software Development	\$15M
Production Sample Calculations	
WBS 3.3.5, Production = \$1M AUC * 22 Qty = \$22M	
WBS 3.3.4, Prod. Eng. = 27% Prog. Eng. Factor * \$22M WBS 3.3.5 = \$5.9M	
Development Sample Calculations	
WBS 3.3.1.2, Dmpt. Hdw. = \$1M Prod. Hdw. AUC * 150% Stepup Factor * 2 Dmpt Qty = \$3M	
WBS 3.3.1, Hardware = \$5M NRE + \$3M Hardware = \$8M	
Dmpt. Factor Base = \$8M Hardware + \$15M Software = \$23M	
WBS 3.2, Systems Eng. = 60% SE Factor * \$23M Dmpt. Factor Base = \$13.8M	

Please review Appendix B for understanding before using the cost factors.

5.0 SUMMARY

The cost-to-cost factors identified in this document and the PEG were developed to assist cost estimators and analysts supporting Investment Analyses (IAs), all FAA organizations, and all product teams and program offices engaged in preparing or revising life cycle cost estimates. However, analysts must keep in mind that the factors should only be used to produce ROM estimates, and analysts should consider other estimating methodologies, particularly when program-specific data becomes available. ASD-410/SETA-II may be contacted for any needed assistance in applying the factors or explaining the development of the factors.

APPENDIX A: DATA SOURCES

Source #1: FAA APO-88-2

- Publisher & Date: Federal Aviation Administration (FAA) Cost Factor Study, APO-88-2, May 1988
- Format: Hard Copy
- Type of Systems: Communications, Radar, and General Electronics
- Phases: Full Scale Engineering Development (FSED) and Acquisition
- Factors applied to: Prime Mission Product (PMP) less Integration and Assembly (I&A)
- Basis of Factors: Not stated. Documentation implies factors developed from actual historical cost data from FAA programs. Specific data points not identified, no fit statistics.
- Comments: Factors do not map directly into current FAA WBS

Source #2: DCA 600-60-1

- Publisher & Date: Defense Information Systems Agency (DISA)/Defense Communications Agency (DCA) Circular 600-60-1, Cost and Planning Factors Manual, Version 1.1, September 1995
- Format: Electronic hypertext system
- Type of Systems: Information systems
- Phases: Production (primarily)
- Factors applied to: Total PMP (generally)
- Basis of Factors: Various, including DCA/DISA experience, Army Cost & Economic Analysis Center (CEAC), and Navy Center for Cost Analysis (NCCA). Specific data points not identified, no fit statistics provided.
- Comments: Secondary source tends to overlap with other data sources

Source #3: Kanter's Factors (ESCP 173-2)

- Publisher & Date: Acquisition Support Cost Factors and Estimating Relationships ("Kanter's Factors"), Air Force Electronic Systems Center (ESC), ESCP 173-2, September 1998
- Format: Hard copy (also documented in ACEIT ACDB)
- Type of Systems: Command, Control, and Communications (C3) systems, Ground and Airborne
- Phases: Development, Production
- Factors applied to: Total PMP (including I&A)

- Basis of Factors: 117 unspecified ESC programs, fit statistics and range of input variables provided
- Comments: Also includes factors for software development and aircraft retrofit modification

Source #4: ASC Planning Factors

- Publisher & Date: Avionics Support Cost Factors, Aviation Systems Center/Financial Management Center (ASC/FMC), Wright-Patterson AFB, OH, Jan 98, ACC 101.140
- Format: Hard copy (documented in ACEIT ACDB)
- Type of Systems: Avionics development programs
- Phases: Development, Production
- Factors applied to: PMP (inclusion/exclusion of I&A not stated)
- Basis of Factors: 20 ASC avionics development programs, no fit statistics or range of input variables provided
- Comments: Source document not available at this time, efforts to obtain underway

Source #5: ACEIT Automated Cost Database (ACDB)

- Publisher & Date: Techolote [under license from USAF]
- Format: Soft copy (library, embedded in ACEIT software)
- Type of Systems: Various
- Phases: Development, Production
- Factors applied to: PMP
- Basis of Factors: Various
- Comments: Documentation for models included in library varies widely

Source #6a: Prototype-to-Production Step-Down Model

- Publisher & Date: MCR Federal, 1990
- Format: Hard copy
- Type of Systems: Wide range of large ground and airborne systems
- Phases: Development, Production
- Factors applied to: PMP
- Basis of Factors: Approximately 20 programs, fit statistics provided
- Comments: Model can be run in either “direction” – to calculate development cost based on production cost and vice versa

Source #6b: C3 Hardware Maintenance CERs

- Publisher & Date: MCR Federal, December 1997
- Format: Hard and Soft Copy
- Type of Systems: Communications, Instrument/Flight control, and Radar/Navigation avionics systems
- Phases: Operations & Maintenance
- Factors applied to: N/A – CERs driven by aircraft quantity, utilization rates, and aircraft type
- Basis of Factors: 67 avionics system used in 40 different aircraft
- Comments: Only O&M factor/CER identified to date

Source #7: Trac2es

- Publisher & Date: United States Transportation Command (TRANSCOM) Regulating and Command and Control Evacuation System (Trac2es), developed by Booz-Allen & Hamilton
- Format: Electronic
- Type of System: Developed software with COTS hardware
- Phases: Development
- Factors applied to: PMP
- Basis of Factors: Actual historical cost
- Comments: Recent program viewed as typical for program type

APPENDIX B: COST FACTOR DETAIL

Development Factors

WBS 3.2 System Engineering

- Phase: Development: factor should be applied to sum of WBS 3.3.1, HW, and WBS 3.3.2, SW
- Scope: Contractor SE/PM during Development
- Number of Factor Sources: 5
- Minimum Value: 31% (APO-88-2 Radar)
- Maximum Value: 86% (Trac2es)
- Typical Value: 60%
- Low Tendencies: Hardware Intensive
- High Tendencies: Software Intensive
- Comments: Includes contractor Systems Engineering and Program Management effort

WBS 3.3.1.2 PMP Hardware

- Phase: Development: factor should be applied to WBS 3.3.5, Production Hardware Average Unit Cost (AUC)
- Scope: PMP in Development
- Number of Factor Sources: 1
- Minimum Value: 100% (MCR Step-down Study)
- Maximum Value: 200% (MCR Step-down Study)
- Typical Value: 150% (MCR Step-down Study)
- Low Tendencies: All Commercial-Off-the-Shelf (COTS)
- High Tendencies: New Development
- Comments: Factors represent approximation of CER

WBS 3.3.3 HW/SW Integration, Assembly, Test, and Checkout

- Phase: Development: factor should be applied to sum of WBS 3.3.1, HW, and WBS 3.3.2, SW
- Scope: I&A of prototype/initial PMP systems
- Number of Factor Sources: 2
- Minimum Value: 10% (APO-88-2 Electronics, Kanter's Factors)
- Maximum Value: 24% (APO-88-2 Communications)
- Typical Value: 16% (APO-88-2 Composite)
- Low Tendencies: Hardware Intensive

- High Tendencies: Software Intensive
- Comments: None

WBS 3.4.1 Facility Planning and Design

- Phase: Development: factor should be applied to sum of WBS 3.3.1, HW, and WBS 3.3.2, SW
- Scope: NRE for new/modified facilities
- Number of Factor Sources: 1
- Minimum Value: 2% (APO-88-2 Communications)
- Maximum Value: 47% (APO-88-2 Electronics)
- Typical Value: 24% (APO-88-2 Composite)
- Low Tendencies: Software Intensive
- High Tendencies: Hardware Intensive
- Comments: None

WBS 3.5.1 System Development Test and Evaluation

- Phase: Development: factor should be applied to sum of WBS 3.3.1, HW, and WBS 3.3.2, SW
- Scope: DT&E at end of Development
- Number of Factor Sources: 5
- Minimum Value: 5% (DCA 600-60-1)
- Maximum Value: 27% (ASC Factors)
- Typical Value: 15% (APO-88-2 Electronics)
- Low Tendencies: Minor modification of existing system
- High Tendencies: New capability
- Comments: None

WBS 3.6 Documentation

- Phase: Development: factor should be applied to sum of WBS 3.3.1, HW, and WBS 3.3.2, SW
- Scope: Development of documentation
- Number of Factor Sources: 4
- Minimum Value: 1% (Trac2es)
- Maximum Value: 27% (ASC Factors)
- Typical Value: 21% (APO-88-2 Composite)
- Low Tendencies: Minor modification of existing system
- High Tendencies: New capability
- Comments: None

WBS 3.7.3 Support and Handling Equipment Acquisition (CSE)

- Phase: Development: factor should be applied to sum of WBS 3.3.1, HW, and WBS 3.3.2, SW
- Scope: CSE required during Development
- Number of Factor Sources: 3
- Minimum Value: 2% (Kanter's Factors)
- Maximum Value: 11% (Kanter's Factors)
- Typical Value: 8% (APO-88-2 Communications)
- Low Tendencies: Minor modification of existing system
- High Tendencies: New capability
- Comments: None

WBS 3.7.4 Support Facilities Construction/Conversion/ Expansion

- Phase: Development: factor should be applied to sum of WBS 3.3.1, HW, and WBS 3.3.2, SW
- Scope: Design/NRE efforts
- Number of Factor Sources: 1
- Minimum Value: 10%
- Maximum Value: 20%
- Typical Value: 14% (APO-88-2 Electronics & Composite)
- Low Tendencies: Software Intensive
- High Tendencies: Hardware Intensive
- Comments: None

WBS 3.7.5 Support Equipment Acquisition/Modification

- Phase: Development: factor should be applied to sum of WBS 3.3.1, HW, and WBS 3.3.2, SW
- Scope: Development of PSE
- Number of Factor Sources: 4
- Minimum Value: 1% (APO-88-2 Radar)
- Maximum Value: 34% (APO-88-2 Communications)
- Typical Value: 10% (DCA-600-60-1 & APO-88-2 Composite)
- Low Tendencies: Minor modification of existing system
- High Tendencies: New capability
- Comments: None

WBS 3.7.7 Initial Spares and Repair Parts

- Phase: Development: factor should be applied to sum of WBS 3.3.1, HW, and WBS 3.3.2, SW
- Scope: Spares required to support prototype/initial PMP items
- Number of Factor Sources: 2
- Minimum Value: 1% (APO-88-2 Communications)
- Maximum Value: 39% (APO-88-2 Electronics)
- Typical Value: 19% (APO-88-2 Composite)
- Low Tendencies: Software Intensive
- High Tendencies: Hardware Intensive
- Comments: None

WBS 3.7.8 Initial Training

- Phase: Development: factor should be applied to sum of WBS 3.3.1, HW, and WBS 3.3.2, SW
- Scope: Development of training and conduct of Type 1 Training
- Number of Factor Sources: 4
- Minimum Value: 1% (APO-88-2 All, Kanter's Factors)
- Maximum Value: 17% (ASC Factors)
- Typical Value: 10%
- Low Tendencies: Minor modification of existing system
- High Tendencies: New capability
- Comments: None

Production Factors

WBS 3.3.4 Production Engineering

- Phase: Production: Factor should be applied to WBS 3.3.5, Production
- Scope: Contractor SE/PM during Production
- Number of Factor Sources: 5
- Minimum Value: 12% (APO-88-2, Electronics)
- Maximum Value: 40% (ACEIT analysis)
- Typical Value: 27% (Kanter's Factors)
- Low Tendencies: Hardware Intensive
- High Tendencies: Software Intensive
- Comments: None

WBS 3.4.3 Physical Infrastructure

- Phase: Production: Factor should be applied to WBS 3.3.5, Production
- Scope: Facilities construction and modification at operational sites
- Number of Factor Sources: 1
- Minimum Value: 7% (APO-88-2 Communications)
- Maximum Value: 21% (APO-88-2 Radar)
- Typical Value: 13% (APO-88-2 Composite)
- Low Tendencies: Software Intensive
- High Tendencies: Hardware Intensive
- Comments: None

WBS 3.5.4 Site Acceptance Testing

- Phase: Production: Factor should be applied to WBS 3.3.5, Production
- Number of Factor Sources: 2
- Scope: ST&E during Production
- Minimum Value: 5% (APO-88-2 Electronics)
- Maximum Value: 10% (APO-88-2 Communications)
- Typical Value: 7% (Kanter's Factors, APO-88-2 Composite)
- Low Tendencies: Minor modification of existing system
- High Tendencies: New capability
- Comments: None

WBS 3.6 Documentation

- Phase: Production: Factor should be applied to WBS 3.3.5, Production
- Scope: Documentation during production
- Number of Factor Sources: 5
- Minimum Value: 4% (APO-88-2 Communications, DCA 600-60-1)
- Maximum Value: 10% (DCA 600-60-1)
- Typical Value: 6% (Kanter's Factors)
- Low Tendencies: Minor modification of existing system
- High Tendencies: New capability
- Comments: None

WBS 3.7.3 Support and Handling Equipment Acquisition

- Phase: Production: Factor should be applied to WBS 3.3.5, Production
- Scope: Acquisition of CSE to support production items
- Number of Factor Sources: 2

- Minimum Value: 1% (APO-88-2 Electronics, Kanter's Factors)
- Maximum Value: 3% (APO-88-2 Composite)
- Typical Value: 2%
- Low Tendencies: Minor modification of existing system
- High Tendencies: New capability
- Comments: None

WBS 3.7.5 Support Equipment Acquisition/Modification (PSE)

- Phase: Production: Factor should be applied to WBS 3.3.5, Production
- Scope: Fabrication/procurement of PSE to support fielded PMP
- Number of Factor Sources: 4
- Minimum Value: 2% (Kanter's Factors)
- Maximum Value: 23% (ASC Factors)
- Typical Value: 10% (DCA 600-60-1)
- Low Tendencies: Minor modification of existing system
- High Tendencies: New capability
- Comments: None

WBS 3.7.6 Support Facilities and Equipment

- Phase: Production: Factor should be applied to WBS 3.3.5, Production
- Scope: Facilities construction & modification at support sites
- Number of Factor Sources: 1
- Minimum Value: 1%
- Maximum Value: 3%
- Typical Value: 2% (APO-88-2 Radar & Composite)
- Low Tendencies: Software Intensive
- High Tendencies: Hardware Intensive
- Comments: None

WBS 3.7.7 Initial Spares and Repair Part Acquisition

- Phase: Production: Factor should be applied to WBS 3.3.5, Production
- Scope: Initial spares at operational sites
- Number of Factor Sources: 3
- Minimum Value: 7% (APO-88-2 Radar)
- Maximum Value: 37% (APO-88-2 Communications)
- Typical Value: 15% (APO-88-2 Composite)
- Low Tendencies: Software Intensive

- High Tendencies: Hardware Intensive
- Comments: None

WBS 3.7.8 Initial Training

- Phase: Production: Factor should be applied to WBS 3.3.5, Production
- Scope: Training of initial operational staff (Type 2 training)Number of Factor Sources 2:
- Minimum Value: 1% (APO-88-2 Electronics, Kanter's Factors)
- Maximum Value: 3% (APO-88-2 Communications)
- Typical Value: 2% (APO-88-2 Composite)
- Low Tendencies: Minor modification of existing system
- High Tendencies: New capability
- Comments: None

WBS 4.6 Installation and Checkout

- Phase: Production: Factor should be applied to WBS 3.3.5, Production
- Scope: I&A of PMP at operational locations
- Number of Factor Sources: 3
- Minimum Value: 18% (APO-88-2 Communications)
- Maximum Value: 34% (Kanter's Factors)
- Typical Value: 20% (DCA 600-60-1)
- Low Tendencies: Software Intensive
- High Tendencies: Hardware Intensive
- Comments: None

WBS 5.3 Modifications

- Phase: Production: Factor should be applied to WBS 3.3.5, Production
- Scope: Modifications to PMP after fielding
- Number of Factor Sources: 1
- Minimum Value: 30% (DCA 600-60-1)
- Maximum Value: 30% (DCA 600-60-1)
- Typical Value: 30% (DCA 600-60-1)
- Low Tendencies: Software Intensive
- High Tendencies: Hardware Intensive
- Comments: None

WBS 5.8.1 Supply Support

- Phase: Production: Factor should be applied to WBS 3.3.5, Production
- Scope: Supply support required to ensure continued operation of PMP
- Number of Factor Sources: 1
- Minimum Value: 5%
- Maximum Value: 10%
- Typical Value: 7% (DCA 600-60-1)
- Low Tendencies: Software Intensive
- High Tendencies: Hardware Intensive
- Comments: None

WBS 5.8.2 Repair

- Phase: Production: Factor should be applied to WBS 3.3.5, Production
- Scope: Depot Level Repairables (DLRs)
- Number of Factor Sources: 2
- Minimum Value: 7% (DCA 600-60-1)
- Maximum Value: 24% (DCA 600-60-1)
- Typical Value: 10% (approximation of MCR CER)
- Low Tendencies: Software Intensive
- High Tendencies: Hardware Intensive
- Comments: None